# Flagstaff Watershed Protection Project

## Invasive Plant Species Report

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for:
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# Introduction

The following report summarizes the affected environment and environmental consequences of the actions described in the Flagstaff Watershed Protection Project (FWPP) on noxious or invasive weed infestations within or nearby the project area. This report will also address mitigation measures necessary to minimize the impacts of management actions undertaken in this project. This specialist report was developed in consideration of the best available science.

## *Laws and Regulations*

Below is a partial list of federal and state laws, executive orders, and Forest direction pertaining to project-specific planning and environmental analysis for this project as they relate to invasive plant species.

- Coconino National Forest Land and Resource Management Plan, 1987 (as amended).
- Resource Planning Act, 1974 (as amended). This act directs the National Forest Service to inventory, protect and address the effects to natural resources.
- Multiple-Use Sustained-Yield Act of 1960. This act designates multiple uses with equal standing in the National Forests. These include recreation, range, timber, watershed, wildlife and fish. It introduces the principles of multiple use and sustained yield on the National Forests.
- National Environmental Policy Act, 1969. This act requires all federal agencies to analyze the effects of management actions and prepare Environmental Assessments or Environmental Impact Statements to address these impacts (depending on the complexity of the project).
- National Forest Management Act, 1976 (as amended); 36 CFR 219. The NFMA Act originated as an amendment to the Resources Planning Act (1974) to address legal challenges. It provided direction requiring an interdisciplinary and systematic approach to resource management and provided for public input on preparing and revising forest plans.
- Executive Order 13112 of 1999, regarding noxious weed or invasive plant species control. This executive order is one of the founding directives of the noxious or invasive weed control on National Forest system lands.
- Forest Service Manuals 2900 and 2150 and Regional Supplement No. 2100-98-1, regarding noxious weed control.
- Noxious Weeds Strategic Plan Working Guidelines– Coconino, Kaibab, and Prescott National Forests (1998). These working guidelines were developed by the three forests to manage noxious or invasive weeds. Noxious weed invasions were recognized as an emerging issue and growing problem.
- Arizona State regulations R3-4-244, R3-4-245 require that the landowner must have an active management program to prevent further spread of weeds and reduce numbers of existing populations.
- Final Environmental Impact Statement for the Integrated Treatment of Noxious or Invasive Weeds, Coconino, Kaibab and Prescott National Forests within Coconino, Gila, Mojave and Yavapai Counties, Arizona (USFS, 2005), incorporated into the Forest Plan by Plan Amendment 20 (2005).

## *Overview of Issues Addressed*

No issues for noxious or invasive weed species were identified through the scoping process.

## *Methodology*

The Noxious or Invasive Weed list for Coconino, Kaibab, and Prescott National Forests was reviewed for this project. Data sources used in preparation of this report include survey data and reports collected by District and Supervisor's Office crews in past field seasons. Additional resources include forest weed files and past survey documents.

### Data Sources

- Noxious or invasive weed species survey, inventory, and treatment data from NRIS database
- Coconino Forest Land Management Plan, 1987, as amended
- Final Environmental Impact Statement for the Integrated Treatment of Noxious or Invasive Weeds for Coconino, Kaibab, and Prescott National Forest (Weed FEIS; USFS, 2005)

### Incomplete and Unavailable Information

On the Forest, surveys for noxious or invasive weeds are typically conducted on a project-by-project basis. No such survey effort has occurred specifically for the FWPP at this time; however previous surveys conducted for other similar fuels reduction and forest health projects has occurred within and adjacent to the project area (see Existing Conditions). Before the beginning of project-related ground-disturbing activities, an inventory of noxious or invasive weeds would occur in project operating areas, along access routes and in areas immediately adjacent to the project area. Existing infestations would be prioritized for treatment or avoided during project implementation.

# Affected Environment

## *Existing Condition*

FWPP consists of approximately 10,543 acres divided between two project areas: Dry Lake Hills, which is approximately 7,569 acres and Mormon Mountain, which is approximately 2,974 acres. Both sites are composed of stands of predominantly ponderosa pine and mixed conifer with an understory of needle litter, grass, and some shrub (see Fuels and Fire and Silviculture reports for more detail).

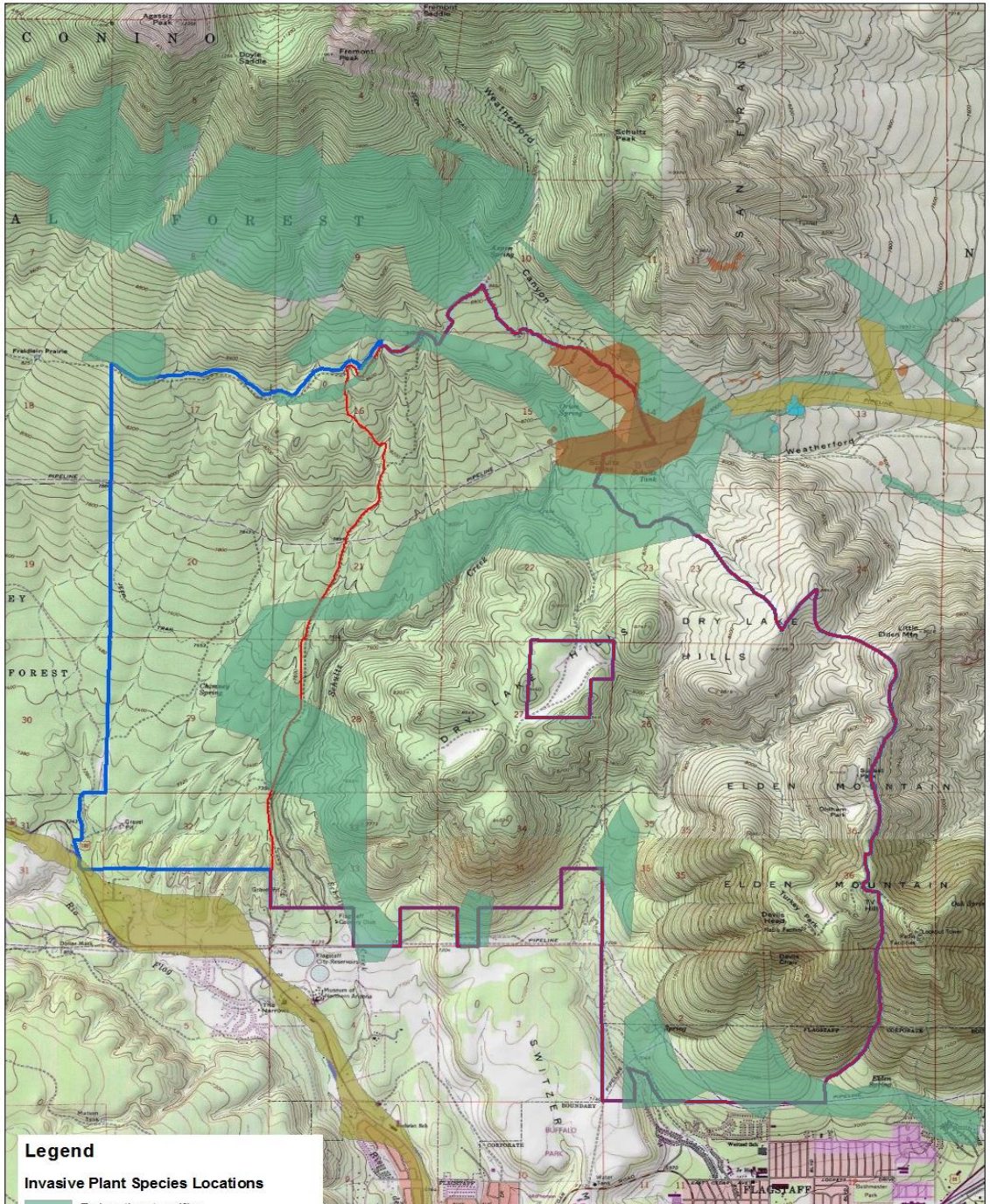
Noxious or invasive weeds can alter ecosystem processes, species composition, species richness, biodiversity, hydrologic functions and soil characteristics (Harrod, 2001). Noxious or invasive weeds can also affect structure and function of native ecosystems and can affect factors such as fire interval and intensity, and successional pathways.

Information about populations of noxious and invasive plant species inside and adjacent to the project boundaries and areas adjacent are from survey efforts related to other projects that occurred between 2004 and 2012 (Table 1). Infestations during previous survey efforts ranged from a few scattered plants to more dense populations.

**Table 1. Noxious or invasive weed species detected in or adjacent to the Dry Lake Hills and Mormon Mountain portions of the Flagstaff Watershed Protection Project.**

| Common Name | Species[1] | Species Rank | Objectives | Documented Locations |
|---|---|---|---|---|
| Leafy spurge | *Euphorbia esula* | 1 | Eradicate | In vicinity of Mormon Mountain project area |
| Musk thistle | *Caruus nutans* | 8 | Eradicate | Adjacent to Dry Lake Hills project area |
| Diffuse knapweed | *Centaurea diffusa* | 9 | Contain/Control | Within and adjacent to Dry Lake Hills project area |
| Scotch thistle | *Onopordum acanthium* | 11 | Eradicate/Control | Adjacent to Dry Lake Hills project area |
| Dalmatian toadflax | *Linaria dalmatica* | 18 | Contain/Control | Within Dry Lake Hills and adjacent to both project areas |
| Bull thistle | *Cirsium vulgare* | 20 | Contain/Control | Adjacent to Dry Lake Hills project area |
| Cheatgrass | *Bromus tectorum* | 22 | Contain/Control specific populations | Adjacent to Dry Lake Hills project area |

[1]Each species is rated by the perceived severity and risk to Forest resources and is based on invasiveness and the predicted success of control measures of each species as analyzed in the Weed FEIS. The ratings were taken from the FEIS.


Legend
Invasive Plant Species Locations
C O N I N O
A L F O R E S T
FOREST
Weatherford
Canyon
DRY LAKE HILLS
ELDEN MOUNTAIN
ELDEN MOUNTAIN
FLAGSTAFF

noxious or invasive weed populations in and adjacent to the Dry Lake Hills and Mormon Mountain project areas. Species known to be present are described in detail below.

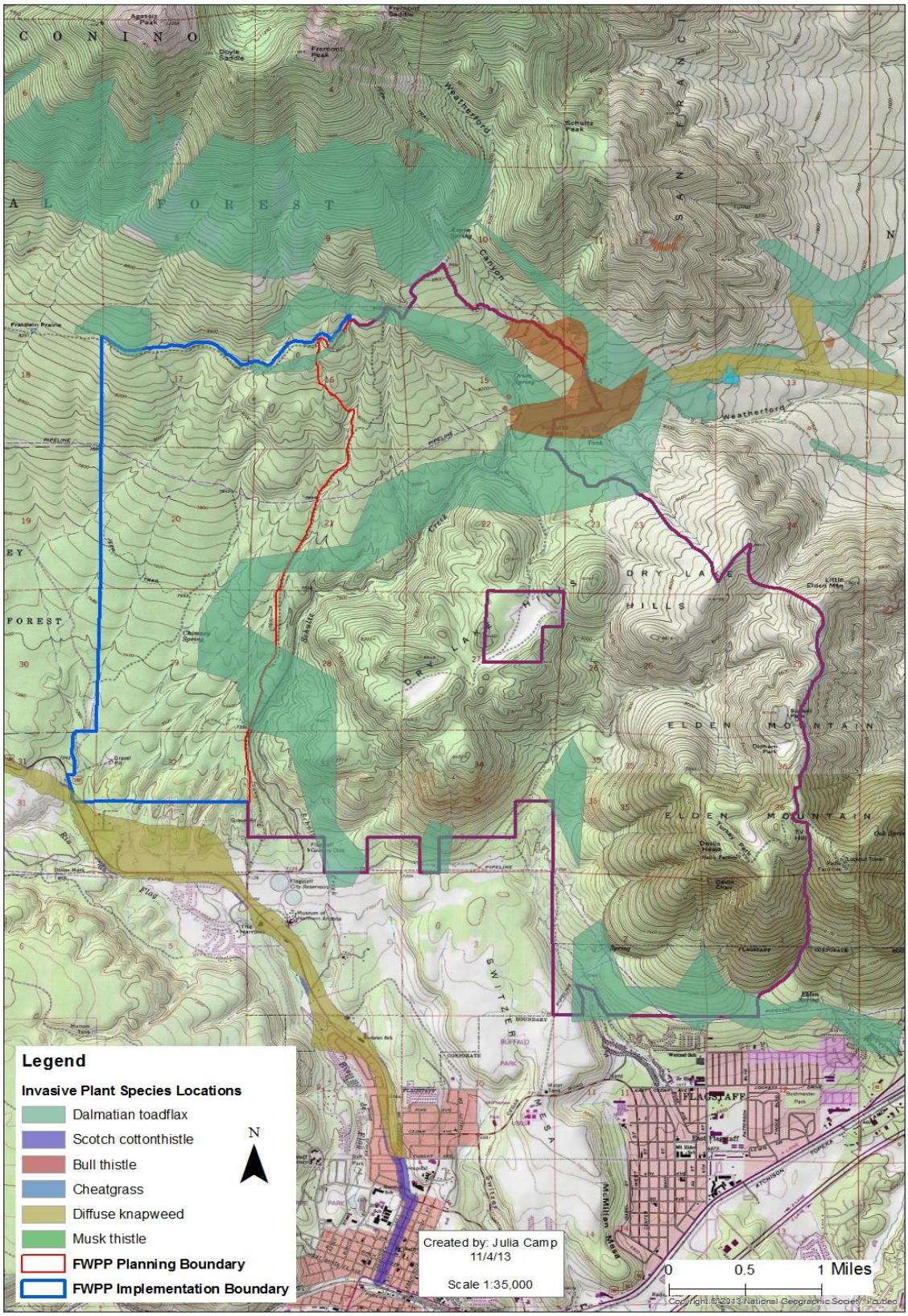



**Figure 1. Known locations of noxious and invasive weed species in and adjacent to the Dry Lake Hills project area of the Flagstaff Watershed Protection Project.**

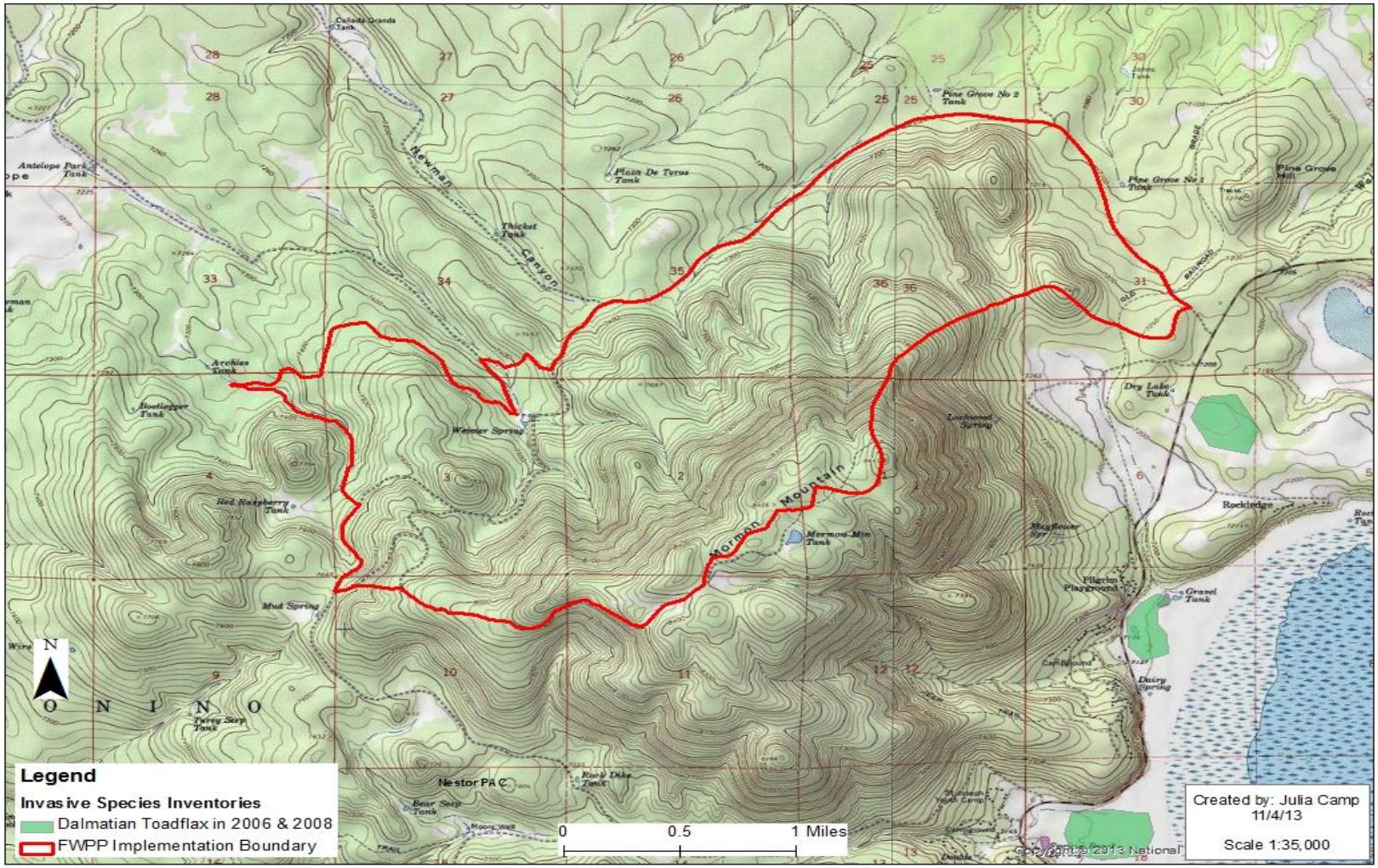



**Figure 2. Known locations of noxious and invasive weed species in and adjacent to Mormon Mountain project area of the Flagstaff Watershed Protection Project.**

### Leafy spurge (*Euphorbia esula*)

Leafy spurge is an insidious weed from Eurasia that is very difficult to control. Roots of this species form extensive underground systems that can extend over 30 feet into the soil, and laterally as well. Seeds, forcefully expelled, can travel up to 15 feet from the original plant. The milky latex found in leafy spurge causes lesions around the eyes and mouth when eaten by cattle and some wildlife species. Largely, this species is confined to Brolliar Park, which is approximately 8 miles south of the Mormon Mountain project area, but in 2013, a small but dense population of leafy spurge was incidentally found just south of Forest Road (FR) 90 and the community of Mormon Lake. Since this is species if the highest ranked noxious and invasive weed species on the Forest and FR 90 and Mormon Mountain have not been surveyed for it, leafy spurge will be considered in the effects analysis for this proposed project in the Mormon Mountain project area.

### Musk thistle (*Carduus nutans*)

Musk thistle (also known as nodding plumeless thistle) is a biennial that is found mainly in disturbed soils growing on roadsides, pastures, and forestlands. If not promptly controlled, this species can quickly form a monoculture, out-competing native vegetation. Populations have been reported in various locations in and around Flagstaff including along Highway 180 north of town to the Forest boundary. In the Dry Lake Hills project area, two small populations were found in 2004 north of FR 420, near Orion Spring.

### Diffuse knapweed (*Centaurea diffusa*)

Diffuse knapweed is an annual or short lived perennial and typically invades roadsides and rangelands. This plant is allelopathic, meaning it has the ability to release chemicals into the soil which inhibit the growth of other species in the immediate area. A highly competitive plant, diffuse knapweed can exclude desirable species reducing ground cover and increasing soil erosion. Populations have been located throughout the Flagstaff area. This species has not been documented in either project area in FWPP but has been found along Highway 180 from the Flagstaff to the Forest boundary and northeast of the Dry Lake Hills project area along FR 420 and 743.

### Scotch thistle (*Onopordum acanthium*)

Scotch thistle is a large biennial thistle, native of Europe and eastern Asia. Characteristics of this species include broad, spiny stems with vertical ribs, large, spiny leaves with dense hairs, and violet to reddish flower heads. Scotch thistle grows in disturbed habitats and waste areas and reproduces solely from seed. Seeds are equipped with structures known as pappi, which allow the seeds to disperse on wind currents. Scotch thistle has not been documented in either project area but has been found along Highway 180 between Flagstaff and the Forest boundary.

### Dalmatian toadflax (*Linaria dalmatica*)

Dalmatian toadflax is a perennial forb that reproduces from both seeds and underground root stalks. Dalmatian toadflax populations may not be observed for many years but will re-establish through existing seed bank and root stalks. Due to the reproductive advantage and aggressive nature, this plant has the potential to exclude native vegetation. Dalmatian toadflax is widespread in the ponderosa pine forest type across the Forest. Numerous small infestations have been documented in the Dry Lake Hills project area and areas adjacent to both project areas, often limited to a few plants scattered over large areas.

### Bull thistle (*Cirsium vulgare*)

Bull thistle is a biennial thistle that regenerates from short-lived seed. This plant invades slash piles, old log decks, roadsides, pastures, and other disturbed sites. Bull thistle is found throughout the Coconino National Forest, mainly in the ponderosa pine type. Numerous small infestations have been recorded adjacent to the Dry Lake Hills project area; these are mainly limited to roadsides, past timber harvest areas, and old burns.

### Cheatgrass (*Bromus tectorum*)

Cheatgrass is a winter or spring annual grass widely distributed throughout North America and is common in disturbed sites. If a population becomes dense enough and large enough it can change the fire regime of an ecosystem. No populations have been documented in either project area, but cheatgrass has been found near the junction of FRs 420 and 555 just outside the Dry Lake Hills project area boundary.

## *Desired Condition*

In the FWPP boundaries, desired conditions for noxious or invasive weed species are to prevent the introduction and establishment of new populations and to control and contain current populations. Use of best management practices (BMPs) as outlined in Appendix B of the Weed FEIS would help prevent the introduction of new populations and the spread of existing populations.

# Environmental Consequences

## *Assumptions*

This analysis is based on the following assumptions**:**

- The mitigation measures and design features would be incorporated into project design and implementation
- All treatments would occur as analyzed in the various specialists reports
- Areas to be treated would be for surveyed noxious or invasive weeds before treatments are implemented
- These factors should be considered when identifying survey needs:
    - Likelihood of any of the species addressed in this document occurring within the treatment area
    - Amount of disturbance. For example, surveys may not be needed in areas scheduled for prescribed burning if the treatments are scheduled to be of low intensity.
- The larger the acreage of potential ground disturbance, the greater the area that would need to be surveyed and treated for noxious and invasive weed species prior to and after treatments.

## *Spatial and Temporal Context for Effects Analysis*

The definitions of short-term and long-term effects for this analysis are the same as those used for soils in the Soil and Watershed report: short-term effects are those that last 5 years or less and long-term are those that last longer than 5 years (see Soil/Hydrology Report for more details).

Similarly, the cumulative effects boundary for this analysis is the planning boundaries of both project areas and the timeframe for projects included in the cumulative effects analysis is 15 years. This includes 5 years prior to the start of the project and 10 years afterward to include implementation and 5 years post-implementation.

### Connected Actions, Past, Present, and Foreseeable Activities Relevant to Cumulative Effects Analysis

Activities in the project areas that are likely to cause ground disturbance and therefore contribute to cumulative impacts to noxious or invasive weeds include vegetation management and recreation activities. The potential effects of the following activities were considered in the cumulative effects analysis:

- Vegetation management projects including Four Forest Restoration Initiative (4FRI) and Eastside and Jack Smith Schultz Fuels Reduction projects
- Wildfire and related suppression activities
- Livestock and wild ungulate grazing
- Travel Management Rule (TMR)
- Mount Elden/Dry Lake Hills Recreation Planning Project
- Lands projects including Mormon Mountain communication tower maintenance and Arizona Power Service (APS) transmission line construction
- Climate change
- General recreation activities such as dispersed camping, hiking, biking, and hunting

## *Alternative 1 – No Action Alternative*

Under the No Action Alternative, current management activities would continue. Management actions proposed in the proposed alternative would not occur and the purpose and need would not be met. Any movement towards desired conditions within the project area would have to occur in other previous projects, such as the Jack Smith Schultz and Eastside Forest Health Restoration and Fuels Reduction Projects.

### Direct and Indirect Effects

There would be no effects to noxious or invasive weeds from project-related activities as result of FWPP as no actions would occur under this alternative.

Under this alternative, factors that contribute to fire hazard ratings such as high canopy cover, high stocking rates and fuel build up from down and dead logs would not be reduced. The risk of wildfire transitioning to crown fires would continue to increase in portions of the project area. Severe wildfires often result in complete removal of tree canopy, complete loss of ground cover and understory plant community and alteration of soil structure and nutrients. These conditions provide potential sites for noxious or invasive weed establishment through creation of bare soil, increased light, and absence of competition from desirable native plant species. Therefore, the

increased risk of severe wildfire would continue to increase the risk of noxious or invasive weeds establishing in both project areas.

## Cumulative Effects

The following is an analysis of the potential cumulative effects from past, present/on-going, and reasonably foreseeable future projects on the abundance and distribution of noxious or invasive weeds in the project areas. These include vegetation treatments, fire suppression, recreation uses, grazing, restoration work, TMR, climate change and lands projects such as power lines and communication towers.

Wildfire, fires suppression activities, and the alteration of the fire regime have affected all vegetation through an increase in canopy cover, a decrease in density of understory vegetation, decrease in species composition of understory vegetation, and a decrease in ground cover of understory vegetation. Hydrologic function has also been altered due to past land management. Fire suppression has increased the risk and severity of wildfires across the landscape and increased the risk of soil disturbance, loss of the native plant community and alteration of habitat from wildfire and suppression activities. As a result, the healthy resilient plant community that would be present in many areas is absent and there are fewer desirable understory species present to provide competition that would help reduce the potential invasion from noxious or invasive weeds. Additionally, humans and equipment involved in fire suppression activities can disperse noxious or invasive weed propagules into unaffected areas through attachment of seeds and contaminated soils to boots and tires.

Livestock grazing can affect noxious or invasive weeds through soil disturbance, trampling, consumption of desirable plants that could provide competition for noxious or invasive weeds, and possible introduction of propagules by cattle as seeds and contaminated soil can be transported on their hooves and coats. Seeds can also be transported through the feces of cattle. Potential effects of livestock grazing past, present, and future, are limited to the Mormon Mountain project area as no grazing has occurred in the Dry Lake Hills for approximately 17 years and the allotment has been permanently deferred from grazing per the 2010 Peaks Allotment Decision Notice.

Grazing and browsing by wild ungulates including elk and deer has occurred across both project areas. Similar effects to those describe for livestock would be expected to occur. It should be noted that the numbers of these animals is under the control of the Arizona Game and Fish Department, not the Forest Service.

There are past, on-going, and reasonably foreseeable future vegetation management projects in in both project areas. In Dry Lake Hills, past and on-going activities include Fort Valley Experiment Forest and Eastside and Jack Smith Schultz Fuels Reduction projects. On Mormon Mountain, past and ongoing projects include removal of vegetation and associated ground disturbance for maintenance of the Mormon Mountain communication site and construction of the APS Mormon Mountain line. The one proposed vegetation management project in both areas is 4FRI, which is currently undergoing the NEPA process, and includes vegetation treatments and restoration activities. Mechanized, ground-based thinning and prescribed fire treatments as a result of these projects would cause disturbances to soils and loss of native vegetative cover that can result in the spread of noxious and invasive weeds. These effects are expected to be minimal since similar mitigation measures as proposed for the action alternatives for this project would be implemented, minimizing the amount of disturbance to soils and potential spread of weeds. The

reduction in hazardous fuels from these projects would also reduce the likelihood of an uncharacteristic wildfire and the resulting effects to noxious or invasive weeds.

Cumulative effects from human activities such as dispersed recreation, hiking, biking, horseback riding, hunting, and fire-wood gathering have occurred and will continue to occur in both the project areas. Effects of these activities include ground disturbance and possible dispersal of noxious or invasive weeds into or across the project area. Effects would be expected to occur in small areas scattered across the project areas. As a result, their contribution to cumulative effects would be expected to be insignificant.

The Forest's Travel Management Rule (TMR) Record of Decision was signed September 28, 2011. The cumulative effects to this project could be both positive and negative. The TMR decision resulted in a reduction in the numbers of motorized routes open to the public and the elimination of cross country travel. This decreases the effects of motor vehicles, including crushing of native plants, creating areas of bare soil, transporting weed propagules and increasing the risk of noxious or invasive weeds establishing in the area. Another action that could occur is the decommissioning and obliteration of non-system roads through additional NEPA analyses in accordance with the TMR-designated road system. Such roads would require disturbing activities to help return the road corridor to pre-road conditions. Ground disturbing activity may contribute to the spread of weeds by eliminating competition from existing vegetation and creating bare ground that can be easily invaded than in undisturbed sites. Mitigation measures and design features similar to those for the action alternatives for FWPP would be implemented during these activities, so cumulative effects from TMR would be minimal.

The proposed Mt. Elden – Dry Lake Hills Recreation Planning Project would address the increasing demand for recreational opportunities in the Flagstaff area. It will look at creating new or re-locating existing trails; consolidating, re-locating, or expanding existing trailheads; constructing a hang glider launch pad; and establishing new trailheads with associated parking areas either within or immediately adjacent to the FWPP analysis area. In addition to the potential effects of users of these trails, ground-disturbing activities related to this project could promote the introduction or spread of noxious or invasive weeds across the Dry Lake Hills adding to the effects of FWPP. As discussed for vegetation treatments and TMR, mitigation measure and design features would be incorporate into the planning and implementation of the project, reducing potential additive effects.

Disturbance is a major factor in noxious weed invasions. Global climate change is expected to be a source of widespread disturbances. Higher temperatures would occur and precipitation cycles would be modified from current patterns over large areas. The warmer climate conditions may affect ecosystems by altering biotic and abiotic factors and increase the extent and severity of disturbances for some species (Bradley, et al 2010; Hellmann, et al 2008; Middleton, 2006). Larger and more frequent fires are expected (Marlon et al. 2009). Climate may favor the spread of invasive exotic grasses into arid lands where the native vegetation is too sparse to carry a fire. When these areas burn, they typically convert to non-native monocultures and the native vegetation is lost (USFS 2010).

## *Effects Common to Alternatives 2, 3, and 4*

### Mitigation Measures

The Forest Plan states under General Plan Direction to:

"Prevent any new noxious or invasive weed species from becoming established, contain or control the spread of known weed species, and eradicate species that are the most invasive and pose the greatest threat to the biological diversity and watershed condition."

Table 2 details the mitigation measures and design features included in alternatives 2, 3, and 4 to minimize the effects of management actions on the spread of noxious or invasive weeds in the both portions of FWPP. These measures comply with the current Forest Plan and the Weed FEIS.

**Table 2. Mitigation measures required for all action alternatives of the Flagstaff Watershed Protection Project.**

| | Mitigation | Reason |
|---|---|---|
| 1 | Incorporate weed prevention and control into project layout, design, alternative evaluation and decisions. | Addresses noxious or invasive weeds during project planning and implementation per Forest Plan Direction. |
| 2 | Survey treatment area and evaluate weeds present before implementation. Avoid or remove sources of weed seed and propagules to prevent new weed infestations and the spread of existing weeds | Reduces noxious or invasive weed infestations. |
| 3 | Treat weed infestations within treatment units before implementing treatments. | Forest Plan Direction. |
| 4 | Incorporate BMPs for noxious and invasive weeds as described in Appendix A (from the 2005 Weed FEIS). | Provides guidance and mitigation for noxious or invasive weeds and complies with Forest Plan. |
| 5 | Wash vehicles and equipment prior to entering the project area, when moving from one area to another, and when leaving the project area. | Prevents spread of potential and existing noxious or invasive weeds by vehicles and equipment. Mitigates effects of management actions on existing and potential noxious or invasive weed infestations and complies with Forest Plan Direction. |
| 6 | Manage prescribed burns to promote native species, aid control of existing weed infestations and prevent spread of existing weeds. | Promotes healthy native plant communities and mitigates effects of management actions on existing and potential noxious or invasive weed infestations. |
| 7 | Place slash piles on previously used locations such as old piling sites, old log deck sites, or other disturbed sites to avoid severe disturbance to additional locations where possible. | Reduces loss of native seed bank, limits extent of severe disturbances and reduces severely disturbed sites that are more prone to invasion by noxious or invasive weeds. |
| 8 | Monitor slash pile sites after burning and control noxious or invasive weeds. | Controls weeds, reduces risk of invasion and reduces risk to native species by reducing weed competition. |
| 9 | Review Timber Sale contract clauses for vehicle cleaning and incorporate appropriate clauses. | Complementary to vehicle cleaning clause above. |
| 10 | Avoid existing noxious or invasive weeds during soil disturbing activities associated with rehabilitation of | Mitigates effects to noxious or invasive weeds during road obliteration. |

| | Mitigation | Reason |
|---|---|---|
| | decommissioned roads where possible. | |

## Direct and Indirect Effects

All three action alternatives include burn only treatments, hand thinning treatments, and mechanized thinning treatments on slopes less than 40 percent. Prescribed burning would also be performed after various thinning treatments. Table 3 contains the acres of treatment by method for the three action alternatives in the two project areas. This section describes the potential effects of these activities on noxious or invasive weeds in FWPP.

Direct effects of management activities include ground-disturbing activities that have the potential to increase the acreage and/or density of the existing infestations within the project area. Disturbance may contribute to the spread of weeds by eliminating competition from existing vegetation and creating bare ground that can be more easily invaded than in undisturbed areas. The level of disturbance is important. Severe disturbance removes competitive vegetation, alters nutrient composition, and creates bare soil, increasing the potential for the invasion or spread of noxious or invasive weeds. Management activities that would create localized severe disturbances include pile burn sites, log decks, bare soil created through road construction and decommissioning, and tire tracks created by machinery during mechanical thinning. Typical equipment used for ground-based timber harvesting includes rubber-tired feller bunchers and rubber-tired skidders with tracked dozers used for piling of slash. The amount of disturbance expressed as a percentage of a typical harvest unit (i.e., area included in a timber sale) impacted by compaction, rutting, and/or exposure of bare mineral soil from this type of harvesting has been estimated to be roughly 8 percent associated with feller-buncher and skidding operations, 3 percent associated with machine piling of slash, 3 percent associated with landings, and 3 percent associated with temporary roads (MacDonald, 2013). Other management activities, such as broadcast burning and hand thinning, would also be sources of disturbance but levels would be minimal.

The majority of the analysis area (approximately 55 percent for alternatives 2 and 3 and 50 percent for alternative 4) would be treated by mechanized, ground-based harvesting and yarding methods on slopes less than 40 percent. Ground-based harvesting involves the use of either wheeled or tracked machinery in contact with the ground surface to both cut trees and remove them from the harvest area to landings in a process called yarding (see the Soil/Hydrology Report for more detail). This method of harvesting causes soil disturbance along a network of temporary roads, skid trails, and landings needed to accomplish thinning, increasing the risk of invasion and spread of noxious or invasive weeds.

Treatments that reduce the tree canopy and lower the stand density would indirectly impact understory plants, including noxious or invasive weeds, by increasing sunlight and available nutrients and temporarily decreasing competition between and amongst tree species. Such favorable conditions for noxious or invasive weeds could increase the size and density of existing populations in areas where weed infestations already exist and susceptibility of invasion into new areas. These effects would be minimized by incorporating the mitigation measures and BMPs described in Table 2 and Appendix A, such as survey and treatment of weeds prior to project implementation.

**Table 3. Comparison by acres of treatment methods for the three action alternatives by project area for the Flagstaff Watershed Protection Project.**

| Action Alternative by Project Area | No Treatment | Burn Only | Hand Thinning/ No Yarding | Mechanized Thinning and Yarding (Slopes <40%) | Mechanized Thinning and Yarding (Slopes >40% | Mechanized or Hand Thinning/ Excaliner Yarding | Mechanized or Hand Thinning/ Skyline Yarding | Mechanized or Hand Thinning/ Helicopter Yarding | Mechanized Thinning/ No Yarding | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|
| **DLH – 2** | 1606[1] | 568 | 715 | 3496 | 0 | 594 | 575 | 0 | 15 | 7569 |
| **DLH – 3** | 1606[1] | 568 | 653 | 3496 | 273 | 0 | 0 | 973 | 0 | 7569 |
| **DLH – 4** | 4110[1] | 67 | 438 | 2954 | 0 | 0 | 0 | 0 | 0 | 7569 |
| **MM – 2** | 0 | 402 | 147[2] | 2320 | 0 | 33 | 73 | 0 | 0 | 2975 |
| **MM – 3** | 0 | 402 | 180[2] | 2320 | 73 | 0 | 0 | 0 | 0 | 2975 |
| **MM – 4** | 631 | 34 | 0 | 2310 | 0 | 0 | 0 | 0 | 0 | 2975 |

Abbreviations: DLH – Dry Lakes Hills; MM – Mormon Mountain

Notes: [1] Includes 837 acres of mechanized thinning on slopes less than 40% in the Orion Timber Sale. These treatments are covered under a previously signed NEPA decision. [2] Hand thinning on Mormon Mountain includes aspen regeneration treatments that could include jackstrawing and thinning of encroaching conifers.

A minor amount of hand thinning using chainsaws and hand piling of downed material would be implemented in the various action alternatives. Hand thinning would result in minimal impacts to soils since no construction of temporary roads would be needed and no equipment would be used removal or transport of materials. As a result, soil disturbance and potential impacts to noxious or invasive weeds would be negligible.

As described in the Soil/Hydrology Report, the road system needed to conduct logging operations has been identified as the largest contributor to bare mineral soil of a harvest operation (Megahan and King, 1972). Temporary roads are constructed during timber harvesting to facilitate access to timber stands and are rehabilitated after treatment by restoring the roadbed to its pre-disturbance condition to the extent possible. Some of the proposed temporary roads in FWPP would be constructed on existing road prisms that were previously Forest Service system roads. Table 4 contains the miles of temporary roads that would be created and rehabilitated for the three action alternatives by project area.

**Table 4. Comparison by miles of roads to be created for the three action alternatives by project area for the Flagstaff Watershed Protection Project.**

| Action Alternative by Project Area | Miles of New Temporary Roads | Miles of Temporary Roads to be Created on Existing Road Prism | Miles of Roads to be Rehabilitated after Project Completion |
|---|---|---|---|
| **DLH – 2** | 14.6 | 2.8 | 17.4 |
| **DLH – 3** | 9.9 | 2.8 | 12.7 |
| **DLH – 4** | 9.2 | 1.0 | 10.2 |
| **MM – 2** | 1.1 | 2.5 | 3.6 |
| **MM – 3** | 0 | 2.5 | 2.5 |
| **MM – 4** | 0 | 2.5 | 2.5 |

Abbreviation: DLH – Dry Lake Hills; MM – Mormon Mountain.

Burning is a disturbance that can release nutrients, reduce plant competition, increase the amount of available sunlight and increase bare soil. Prescribed burning may have direct and indirect effects to on all understory vegetation depending on fire severity, including existing noxious or invasive weed populations within the project area. In FWPP, most prescribed burning would be of low severity with low soil heating, retention of most ground litter and little or no change in mineral soil and therefore minimal effects on the abundance of noxious or invasive weeds (Fowler et al, 2008; Collins et al, 2007). In some areas, moderate to high severity fire may occur during a prescribed burn, resulting in similar effects to those described for pile burning or wildfires (McGlone and Egan, 2009).

Pile burning would create localized severely burned areas. Potential consequences include the reduction or loss of the seed bank on these sites (Korb, 2001); death or reduction of soil organisms on the pile sites (Raison, 1979; Ballard, 2000; Korb et al., 2004) and development of hydrophobic soil (Kaye and Hart, 1998; Ballard, 2000). Pile sites are more prone to invasion from noxious or invasive weeds than surrounding areas and may contribute to the persistence and

spread of noxious or invasive weeds in treated areas. Pile burning sites would constitute a very small portion of the project area (i.e., less than 5 percent). To minimize these effects, previously disturbed areas including old pile sites or previously used decking areas would be used where available instead of creating new sites within the project area. Additionally, pile sites would be monitored after burning occurs to identify and treat any weed infestations. Management actions can be mitigated by following the BMPs described in the Weed FEIS in Appendix A.

Potential direct and indirect effects of temporary road construction, road maintenance or obliteration include disturbance and increased risks of dispersal of existing weed species and populations and introduction of new species. The density of noxious or invasive weeds tends to be greater along roadways than in interior areas with fewer disturbances (Fowler et al, 2008). These potential impacts can be mitigated by following the mitigation measures and design features in Table 2. Roads that would be obliterated as part of Flagstaff Watershed Protection Project would be complementary to the goals of TMR.

### Cumulative effects

Cumulative effects as described under the no action alternative would be combined with direct/indirect effects to noxious or invasive weeds for all alternatives as described above. Effects of all the activities in the project areas could result in short-term increases in the abundance and density of noxious or invasive species immediately following ground-disturbing activities. However, with the distribution of ground-disturbing activities across the project areas at different times and the implementation of mitigation measures to minimize effects, these impacts would be insignificant. Additionally, by reducing the risk of wildfire and related suppression activities and treating existing infestations in the project areas prior to project implementation, long-term effects of these activities would likely result in a decrease in the number and size of infestations and the rate of spread.

## *Alternative 2 – Proposed Action with Cable Logging Emphasis on Steep Slopes*

In this section, only the differences between Alternative 2 and the other action alternatives will be discussed.

Two different methods of cable yarding are proposed under this alternative: skyline and excaliner. As described in detail in the Soils/Hydrology Report, the types of ground disturbance created by cable yarding are the same as for ground-based mechanized harvesting but the magnitude of disturbance is lower for cable yarding. One study found that ground-based yarding produced the most soil disturbance (approximately 8.2 percent of harvested area minus roads), followed by cable yarding (approximately 3.8 percent), and helicopter yarding (approximately 0.2 percent) (Reeves et al, 2011). Knowing this, Alternative 2 would be expected to have the highest amount of soil disturbance from mechanized thinning of the three action alternatives: 1,169 acres in Dry Lake Hills and 106 acres in Mormon Mountain (Table 3). Additionally, Alternative 2 requires the largest mileage of temporary roads to be created and rehabilitated: 17.4 miles in Dry Lake Hills and 3.6 in Mormon Mountain (Table 4). As a result, Alternative 2 would disturb the largest area of the three action alternatives, increasing the risk for the invasion or spread of noxious or invasive weeds in the project areas. As discussed before, the risk of invasion and spread would be minimized through the mitigation measures and BMPs described in Table 2 and Appendix A.

## *Alternative 3 – Proposed Action without Cable Logging*

In this section, only the differences between Alternative 3 and the other action alternatives will be discussed.

There are several differences between Alternatives 2 and 3. First, no cable yarding would occur in either project area under this alternative. Instead, 973 acres in Dry Lake Hills would be mechanically thinned and yarding would occur by helicopter. Since helicopters would be used to transport logs to landings, there would be no need for skid trails and cable corridors, resulting in a reduction in potential soil disturbance.

Another difference is thinning and yarding by specialized equipment on slopes greater than 40 percent would occur on 273 acres in Dry Lake Hills and on 73 acres in Mormon Mountain. This would be done with either multi-wheeled harvesters or track mounted levelling feller-bunchers designed for operation on steep slopes. As described in the Soil/Hydrology Report, through use of BMPs, soil disturbance would be expected to be light to moderate on slopes where this equipment was used (i.e., no more than 9 percent exposure of bare mineral soil). This is similar to the level of disturbance from ground-based thinning on slopes less than 40 percent. If exposure of bare mineral soil greater than 9 percent were to be observed during implementation, slash mats would be used to protect soils. Mats would be created by delimbing felled trees and placing them in the path of the harvester(s). This would protect soils from disturbance and reduce the potential impacts of noxious or invasive species in both project areas.

Implementation of these two methods would also result in a decrease in the number of temporary roads that would need to be created and rehabilitated under Alternative 3: 12.7 miles in Dry Lake Hills and 2.5 miles in Mormon Mountain.

Under Alternative 3, the decrease in acres of soil disturbance under this alternative through the use of different harvest methods and the related decrease in miles of roads created and rehabilitated would result in a decreased risk of invasion or spread of noxious or invasive weeds when compared with Alternative 2.

## *Alternative 4 – Minimal Treatment Approach*

Under Alternative 4, treatments would occur on a smaller number of acres than under Alternatives 2 and 3: a reduction of 2,504 acres in Dry Lake Hills and 631 acres in Mormon Mountain. Additionally, there would be no treatments that involve cable or helicopter yarding or the use of specialized steep-slope equipment. While the same number of miles of temporary roads would be created and rehabilitated on Mormon Mountain under Alternatives 3 and 4, there would be a decrease of 1.1 miles created and rehabilitated between Alternatives 2 and 4. In Dry Lake Hills, there would be a decrease of 7.2 and 2.5 miles of temporary roads under Alternative 4 when compared with Alternative 2 and 3, respectively. These differences would result in the least amount of soil disturbance of the three action alternatives and therefore the lowest risk of invasion or spread of noxious or invasive weeds.

## *Forest Plan Amendments*

Amendment 1 to the Forest Plan would allow mechanical treatments and hand thinning in Mexican spotted owl protected activity center treatments and prescribed burning within nest cores. The amendment would also allow removal of trees 24 inches dbh and greater in Mexican spotted owl protected or recovery habitat for cable logging corridors in order to facilitate treatments under Alternative 2. Implementation of this amendment would result in increases in the amount of soil disturbance in the project area since larger areas would be thinned and burned. This would result in a short-term increase in the risk of invasion and spread of noxious or invasive weeds. Over the long-term, improved vegetative ground cover would occur by providing conditions conducive to the establishment of a more vigorous understory of grasses, forbs and shrubs. This improvement in the health of vegetative ground cover would reduce the risk of the effects of high severity fire while improving the ability of native plants to compete

with noxious and invasive weeds. Proposed population and habitat monitoring would not increase the risk of invasion or spread of noxious or invasive weeds as soil disturbance from these activities would be very limited or not occur.

Implementation of Amendment 2 to allow mechanical harvesting on slopes greater than 40 percent within the project area would have similar impacts to those described for Amendment 1. A short-term increase in the risk of invasion and spread of noxious or invasive weeds would occur from the increase in soil disturbance on steep slopes. Over the long-term, this amendment would decrease the risk of high severity wildfire and improve the ability of native vegetation to compete with noxious or invasive weeds. This would result in a long-term decrease risk in the invasion or spread of noxious or invasive weeds.

## Monitoring Recommendations

Noxious or invasive weed species can establish in disturbed sites created from activities such as thinning, piling, prescribed burning, creation of temporary roads and landings, and rehabilitation of decommissioned roads. Due to the likelihood of noxious or invasive weed populations establishing in disturbed sites, areas including pile burn sites, landings, temporary and decommissioned roads in Flagstaff Watershed Protection project areas should be monitored post treatment annually for 5 years.

Monitoring would consist of surveying areas where project-related activities occurred and comparing data from these surveys to those conducted prior to activities occurring. This would allow for any new populations to be documented. If new populations are found, location information would be recorded and appropriate treatment of noxious and invasive weeds would occur.

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# Appendix A. – Noxious or Invasive Weed Best Management Practices

From Appendix B of the Coconino National Forest - Final Environmental Impact Statement for Integrated Treatment of Noxious or Invasive Weeds, 2005)

| Objective | Best Known Practice |
|---|---|
| **1.** Incorporate weed prevention and control into project layout, design, and alternative decisions | 1.1 – Environmental analysis for projects and maintenance programs will need to assess weed risks, analyze potential treatment of high-risk sites for weed establishment and spread, and identify prevention practices. Determine prevention and maintenance needs, including the use of herbicides if needed, at the onset of project planning |
| **2.** Avoid or remove sources of weed seed and propagules to prevent new weed infestations and the spread of existing weeds. | 2.1 – Before ground-disturbing activities begin, **inventory** and **prioritize treatment** of invasive weeds in project operating areas and along access routes, or within reasonably expected potential invasion vicinity. Do a risk assessment accordingly; control weeds as necessary.<br><br>2.2 – After completing "Practice 2.1" above, reduce risk of spreading and creating weed infestations. Plan operating areas and access routes to avoid heavy infestation areas, plan closure of access routes at finish of project, and/or begin project operations in uninfested areas before operating in weed-infested areas. Locate and use weed-free project staging areas. Avoid or minimize all types of travel through weed-infested areas, or restrict to those periods when spread of seed or propagules are least likely.<br><br>Equipment Wash Station – Centralized wash station areas will be developed in several locations throughout the CNF. They must have a filter system, for example at least 6 inches of large cinder or gravel spread over an area 10' x 30′. Filter cloth may be used for temporary stations. The area will be a perched drainage to allow excess moisture to drain after being filtered and must be at least 200 yards from a natural drainage to avoid contamination. All wash station locations must be monitored annually and all weed materials removed as soon as possible.<br><br>2.3 – Remove mud, dirt, and plant parts from project equipment before moving it into a project area. Determine the need for, and when appropriate, identify sites where equipment can be cleaned. Clean all equipment before entering National Forest System lands; a forest officer, in coordination with the unit invasive species coordinator, needs to approve use of on-forest cleaning sites in advance. This practice does not apply to service vehicles traveling frequently in and out of the project area that will remain on a clean roadway. Seeds and plant parts need to be collected when practical and incinerated.<br><br>2.4 – If operating in areas infested with weeds, clean all equipment before leaving the project site. To minimize time spent cleaning equipment, time all work in infested areas last and concurrently, designate a "contaminated" parking lot where project vehicles working in the infested area may be parked for the duration of the project. This area should be monitored in follow-up mitigation and should be near a "clean" vehicle/equipment lot. Identify sites where equipment and vehicles can be cleaned before leaving the site at the end of the project. Seeds and plant parts need to be collected when practical and incinerated. |

| Objective | Best Known Practice |
|---|---|
| | 2.5 – Workers need to inspect, remove, and properly dispose of weed seed and plant parts found on their clothing and equipment after being trained to recognize the priority species in the area. Proper disposal means bagging the seeds and plant parts and incinerating them. 2.6 – Coordinate project activities between resources and between agencies (such as city, county, ADOT, ASLD) with any nearby weed treatments, including herbicide applications, to maximize cost effectiveness of weed treatments.<br><br>2.6 – Coordinate project activities between resources and between agencies (such as city, county, ADOT, ASLD) with any nearby weed treatments, including herbicide applications, to maximize cost effectiveness of weed treatments. |
| **3.** Prevent the introduction and spread of weeds caused by moving infested sand, gravel, borrow, and fill material in Forest Service, contractor and cooperator operations. | 3.1 – Inspect material sources on site annually, and ensure that they are weed-free before use and transport. Treat weed-infested sources for eradication, and strip, stockpile, and treat contaminated material before using pit materials. 3.2 – Inspect and document the areas where materials are used (including those from treated weed-infested sources) annually for at least 3 years after project completion to ensure that any weeds transported to the site are promptly detected and controlled.<br><br>3.2 – Inspect and document the areas where materials are used (including those from treated weed-infested sources) annually for at least 3 years after project completion to ensure that any weeds transported to the site are promptly detected and controlled.<br><br>3.3 – Maintain stockpiled, uninfested material in a weed-free condition.<br><br>3.4 – Work with the responsible transportation agencies to adopt these practices for maintenance of roads that cross National Forest System lands. |
| **4.** Avoid creating soil conditions that promote weed germination and establishment. | 4.1 – Minimize soil disturbance to the extent practical, consistent with project objectives. 4.2 – In those vegetation types that have relatively closed canopies as a natural condition, retain shade to the maximum extent possible to suppress weeds and prevent their establishment and growth in and around project activity. |
| **5.** Where project disturbance creates bare ground, establish vegetation to minimize favorable conditions for weeds. | 5.4 – Monitor and document all limited term ground-disturbing operations near weed infested areas for at least five growing seasons, or the documented seed viability for the species of concern following completion of the project. For ongoing projects, continue to monitor until reasonable certainty is obtained that no weeds have occurred. Provide for follow-up treatments based on inspection results.<br><br>5.5 – Evaluate options, including closure, to minimize future infestations on sites where desired vegetation needs to be established. |
| **Prescribed Fire** | |
| **FM-4.** Manage fire as an aid in control of weeds to prevent new weed infestations and the spread of existing weeds. | 4.1 – Pre-inventory project area and evaluate weeds present with regard to the effects on the weed spread relative to the fire prescription. Remove weeds (live plants and seed sources) before project initiation.<br><br>4.2 – Plan to avoid or remove existing sources of weed seed and propagules. Avoid ignition and burning in areas at high risk for weed establishment or |

| Objective | Best Known Practice |
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| | spread due to burn aftereffects. Treat weeds that establish or spread because of unplanned burning of weed infestations.<br><br>4.3 – Burn noninfested areas first before entering weed infested sections of the burn. Clean all equipment when project is completed. Or treat and burn all infested areas first to remove seed source then clean equipment and proceed to uninfested areas. |
| **FM-5.** Avoid creating soil conditions that promote weed germination and establishment. | 5.1 – Time burns to promote native species and to hinder weed species germination.<br><br>5.2 – Consult weed species specific information and consider effects of current local conditions on species growth. |
| **Timber Harvest Operations and Stewardship Contracting** | |
| **VM-1.** Avoid or remove sources of weed seed and propagules to prevent new weed infestations and the spread of existing weeds. | 1.1 – Treat weeds on contracted projects, emphasizing treatment of weed infestations on existing landings, skid trails, and helibases before activities commence.<br><br>1.2 – Train contract administrators to identify weeds and select lower risk sites for landings and skid trails.<br><br>1.3 – Encourage operators to maintain weed-free mill yards, equipment parking, and staging areas.<br><br>1.4 – Use standard timber sale contract clauses such as WO-C/CT 6.36 to ensure appropriate equipment cleaning. |
| **VM-2.** Retain native vegetation in and around project activity and minimize soil disturbance. | 2.1 – Minimize soil disturbance to no more than needed to meet project objectives. Logging practices to reduce soil disturbance include, but are not limited to:<br><br>• Over-snow logging<br><br>• Skyline or helicopter logging<br><br>• Reuse landings, skid trails and helibases when they are weed free<br><br>2.2 – Minimize period from end of logging to site preparation, revegetation, and contract closure. |
| **Post Vegetation Management Operations** | |
| **VM-3.** Retain native vegetation in and around project activity and minimize soil disturbance. | 3.1 – Minimize soil disturbance to no more than needed to meet vegetation management objectives. Prevention practices to reduce soil disturbance include, but are not limited to:<br><br>Minimizing heat transfer to soil in burning by:<br><br>• Treating fuels in place (broadcast burning) instead of piling<br><br>• Using small, tall steep piles<br><br>• Minimizing fireline construction<br><br>Minimizing soil disturbance by logging techniques:<br><br>• Preference for forwarders that carry logs, rather than skidders that drag logs<br><br>• Using hand fellers instead of machines |

| Objective | Best Known Practice |
|---|---|
| | • Using hand piling rather than machine piling<br>• Avoiding decking logs in the woods<br>• Using low PSI (impact) equipment (big tires) |
| **VM-4.** Encourage native vegetation on bare ground. | 4.1 – Recognize the need for prompt growth of native vegetation, long-term restoration and weed suppression where forested vegetation management has created openings.<br>4.2 – Allow natural seedbank to provide vegetation if possible, next preference is for native seed grown from local collections. All seed must be certified weed seed-free for all species on the forest noxious or invasive weed list. |